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EDITORIAL NOTES

BALLOONS

I.M.N.B.R. to what extent the Gas Industry has been responsible for supporting, in the most literal sense, the balloon barrage which for so long now has been a feature of the skies over Britain. And with this revelation we are able to give some truly astonishing figures of gas consumption in this branch of defence—not by any means exclusively of hydrogen gas. Few of us who inhabit the London area and many parts of Southern England will ever forget the feeling of uplift we received when, as if by magic, the air above us was suddenly thick, that first day of the war, with strange silvery shapes; the sense of security they imparted in an otherwise seemingly insecure world; the belief that, if we who stood on the very ground from which those monsters had taken the air had been unaware of their existence, there must be in other directions also a very much greater state of preparedness than we—or Adolf Hitler—had ever suspected. Alas! But we need not develop this theme.

Yet there must be many even in our own Industry who will be astonished at the part we have played in this branch of the air war, which, although of a defensive nature, only reached its peak after the great offensive had been launched against the enemy. For it is common knowledge that the balloon barrage did some of its finest work as goal keeper during the flying bomb assault against us, the ordinary people, and our humble homes. The story was told last week at a gathering in Southern England, when the R.A.F. formally thanked the Gas Industry for the part it had played in keeping the balloons flying. It was appropriately at the gas-works where the pioneer of many hydrogen plants of a special kind had been installed that Air-Commodore P. L. Lincoln, D.S.O., M.C., Deputy A.O.C. Balloon Command, paid tribute to the Industry for the manner in which, hard pressed as it has been with its more normal service to the nation, it had willingly, and with superb efficiency, shouldered this additional burden. The story is told in other columns of this issue.

B.C.R.A.

WE were happy to attend last Wednesday a most enthusiastic conference at the University of Leeds to mark the inauguration of a new research body—the British Coke Research Association—to add to the growing list of State-aided organizations of the kind. B.C.R.A., however, as was emphasized at the conference, a report of which appears later in this issue, apart from its constitution does not start *de novo*. Rather is it the logical outcome of the work of the Midland, the Northern, and more latterly the Scottish Coke Committees, all of which, as our columns testify, have done excellent service. Now their work is to be co-ordinated and centrally directed and more ample funds are assured. The new Association has been formed under the aegis of the British Hard Coke Association, which is representative of practically 100% of the coke oven undertakings in the United Kingdom, and with the support of the Department of Scientific and Industrial Research. We hope later to detail more precisely its constitution; its aims and objects will be understood in general terms from our report of the conference—a gathering in every way successful. The new body had a warm welcome from the Vice-Chancellor of Leeds University, a seat of learning which has for so many years been so conspicuously identified with fuel research and so closely associated with the gas and coke oven industries; and present at the occasion were Sir Harold Hartley, to give the blessing of the Fuel Research Board, and Sir Hubert Houldsworth that of the Ministry of Fuel and Power. Other speakers included the President of the Institute of Fuel (Dr. E. W. Smith), the Director of Fuel Research (Dr. A. Parker), and the Livesey Professor (Dr. D. T. A. Townend), who read a message from the Director of the Gas Research Board (Dr. J. G. King).

As Sir Harold Hartley said, the British war effort has been dependent on the spirit of the people, on co-ordinated effort, and on scientific research, and, when peace returns, more than ever before shall we have to rely on the application of science to ensure national progress and prosperity. In 1938 something like 10% of the total national income was spent on fuel and power in one form or another, and everything points to the need for effective and co-ordinated fuel research. At the conference we gained the impression, which we sincerely hope is a right one, that the new Coke Research Association is anxious to co-operate with the other fuel research organizations. Such co-operation is indeed essential. In his statement Dr. King, who remarked on the plans of the Gas Research Board in regard to coke research, extended the Board's good wishes and its desire to work co-operatively with the new Association. This is all to the good; we feel sure that in the immediate years ahead, if we are to achieve a better fuel economy in the national interest and in that of the individual fuel user, if we are to bring about a greater measure of smokelessness, to raise domestic convenience and comfort and to increase industrial efficiency, greater attention to the preparation and marketing of solid smokeless fuel is of first importance, and that there should be interlinking of the work of the gas and coke oven industries on what are undoubtedly common problems. We did miss at the conference any reference to the activities of the coke associations linked with the Gas Industry which are now nation-wide in their scope, and which owe their origin to the pioneer efforts of the London and Counties Coke Association; but we take it for granted that here again co-operation will be the keynote.

The basis of support of the new Association is primarily contributions from the coke oven undertakings through the general fund of the British Hard Coke Association, though perhaps it is significant that throughout the conference the term "hard" was studiously avoided. To what extent this implies that the coke oven industry intends in the future to enter the domestic market to better purpose and on a more scientific foundation we are not prepared to give reply, but it does seem to us that there is ample room for additional work in the domestic field, and we look to the activities of B.C.R.A., whatever they may be in this direction, to stimulate our own domestic coke research and more particularly, perhaps, to give further incentive to that of the Gas Research Board in meeting the current and likely requirements of the domestic fuel consumer. The field, as we have said, is immense, and its development calls for proportionate effort.

If enthusiasm is any guide to expectations, the B.C.R.A. is destined to accomplish much. The comprehensive programme which has already been drawn up is too lengthy to be recorded in this brief note. We are impressed with its scope and with its practical nature, and we regard as happy augury the very real support of the work which is being given by the coke oven plant construction firms. If we single out in this connexion the Woodall-Duckham Companies, we do so because of the Gas Industry's appreciation of the technical services so continuously rendered by them to the carbonizing industries. Altogether, then, B.C.R.A. appears to be well set on a chartered course, and we are glad to have the opportunity of wishing the new Association all success.

ROAD TAR

FROM time to time since the war began we have referred in these columns to the close co-operation which has been maintained between the British Road Tar Association and Government departments—co-operation which has led to a growing appreciation of the properties of specified tar for road construction and maintenance, and which is certain to be of immense value to all concerned after the war is over. Apart from increasing the mileage of trunk roads, reconstruction and maintenance of existing roads are likely to be given first priority in any highway programme, and it is equally likely that in the carrying-out of the programme road tar and tarmacadam will be increasingly used. We learn without surprise that specifications for the use of tar in the preparation of roads on new housing sites have been officially recognized by the Ministry concerned.

Since the outbreak of war the activities of the B.R.T.A. have been concerned mainly with problems confronting the Air Ministry, the Admiralty, the War Office, and the Ministry of Works, and experience has been gained which should stand the country in good stead in the transition from war to peacetime conditions. We are thinking of the knowledge gained, for example, in the application of semi-hot process macadam on roads damaged by heavy tank traffic, and other development work carried out in co-operation with the Ministry of War Transport. And the research undertaken by the Department of Scientific and Industrial Research, which has been continued during the war, has provided solid foundation for future advances in scientific knowledge and practical technique. The post-war prospects for road tar are undoubtedly excellent, thanks largely to the strict adherence to very carefully prepared specifications for materials and methods of road construction. As in every field of engineering, so in road construction, proper specifications are the basis of sound practice; and in this regard the wartime work of the British Road Tar Association in collaboration with the British Standards Institution has been quite outstanding. The wartime record of the Association is one of joint effort; and joint effort will be needed in effecting the best and speediest solution to the problems which lie ahead.

Utility Services

"There has appeared recently a new profession of planners who are ready to plan and prepare maps of almost anything. It would, however, be a good thing if some of those planners could spend some months or years on the problem of everyday life with any utility or engineering project. They would then appreciate some of the problems involved." This somewhat caustic comment is quoted from an Address by Mr. J. Paton Watson, Plymouth City Engineer and Surveyor, to the Institution of Civil Engineers. His subject was the positioning, in relation to town and regional planning, of the distribution mains and services of the various public utility undertakings—gas, water, electricity, and Post Office—and he suggested that the distribution engineer has largely contributed to the problems which he has to face by holding himself aloof from surface planning and keeping himself immune from town planning legislation. He went on to point to the need for the utilities engineer to co-operate with the town planner and become one of the town planning team. Engineers of the public utility undertakings should, he contended, assist each other in obtaining the clearest records possible of the positions of the services under their control and supervision. At present records were wholly inadequate; and as a remedy he put forward centralization of all records of services so that copies could be supplied to each undertaking. In his view the work and staff could be co-ordinated by a technical advisory committee of the surveyor and the utility engineer, and standardization of plans, scales, and so on would help greatly. There will be an increase in the demand for services; the best results cannot be obtained without regional planning. That was his main theme. Precise knowledge of the positions of mains and services—under prevailing conditions far too close to one another—was needed for proper control of development, and regional planning would, he thought, allow of the opening up of new land with the provision of services, possibly with assistance to cover initial capital outlay interest charges until the system became remunerative—*i.e.*, before the demand arose. In regard to the allocation of space and the matter of costs there were, he said, two aims—minimum interference with surface traffic, and maximum accessibility to the mains. For the four utilities the cost of road reinstatement appeared to average about £40 a year per 1,000 of the population—this apart from the cost of repairs, excavation, and refill. Would it not be well, he asked, to consider whether better results could not be obtained by better location of the utilities or the provision of more space even at a higher installation cost, if that were offset by reduced annual maintenance charges? Discussing the use of subways in central areas, Mr. Paton Watson, remarking that there is as yet no general acceptance of the basic principle that a subway can be occupied by each utility in common with its fellows, put forward the view that an authoritative investigation of the problems involved and a final expression of opinion by some representative committee would be of great value, and would settle the conditions and occupants for which subways should be designed.

Personal

With a happy reminiscent speech at a well-attended meeting of the staff of the Woodall-Duckham Companies last week, the Chairman, Mr. F. B. Richards, made presentations to Dr. and Mrs. E. W. SMITH on behalf of the staff. Dr. Smith, in returning thanks for a beautiful desk and chair, said that nothing could be better designed to remind him of the happy times he had spent with the Companies. The desk was good to look upon, it was well designed, the parts worked smoothly, it was made of first-class materials, and of good workmanship, and he was certain that it would give good service. The chair too was as comfortable as he had always been. Mrs. Smith also suitably replied.

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Dr. A. KEY, who has been a Research Chemist to The Institution of Gas Engineers (Liquor Effluents and Ammonia Committees since 1931, and to the Gas Research Board since its formation, has recently resigned his appointment on being offered the post of Chemical Inspector at the Ministry of Health. Dr. Key is recognized to be an outstanding authority on the disposal of gas-works liquors. He is also known for his work, carried out under the auspices of the Joint Research Committee of the University of Leeds and the Gas Research Board, on the removal of organic sulphur compounds from gases. At a gathering of members of the staff of the Fuel Department of the University of Leeds, the Livesey Professor, Dr. D. T. A. Towend, who was supported by his predecessor, Emeritus Professor John W. Cobb, referred to the services of Dr. Key to the Industry and to the University. On behalf of those present, Professor Townend made a presentation to Dr. Key in token of the high esteem in which they all held him, and expressed good wishes for his future success and happiness.

* * *

Mr. F. B. HALLIWELL, Distribution Superintendent of the Loughborough Gas Department, has been appointed Distribution Engineer to the Paisley Gas Department. He will be suceeded at Loughborough by Mr. NOEL FORRESTER, of the Peterborough Gas Company.

Letter to the Editor

The Gas "Dunkirk"

DEAR SIR,—Yesterday *The Times* announced and to-day reports (with a leader) the Reception given by the Electrical Association for Women to Lady Astor in celebration of her 25 years in Parliament; the Dinner to Lady Astor given by the British Federation of Business and Professional Women, presided over by Miss Caroline Haslett, Director of the Electrical Association for Women; the Dinner to celebrate the 25th Anniversary of the British Electrical Development Association, at which Sir Lawrence Bragg spoke; Foyle's Literary Luncheon, at which Lord Brabazon, President of the British Electrical Development Association, was the speaker; and a meeting of the Institution of Electrical Engineers.

When last was the Gas Industry featured in the Press, apart from the odd advertisement of a gas cooker for sale, or the report of a fatality involving coal-gas? There was, a little over a year ago, an excellent Press on the Industry's Planning Report, but apparently this was so gratuitous and unexpected as to have induced silence in the Industry, not even broken by published reference to the ingenious reasons, of which one hears, for not proceeding to implement that Report.

Is this not typical of our recent history? Are we turgid with tradition, satiated with self-sufficiency, imbued with indolence, or merely masters at mesmerizing ourselves? Maybe not, but if happily we avoid the consequences of our failure to act with vigour as an organized Industry, we should give thanks in the words of Shakespeare:

"Sweet are the uses of adversity;
Which, like the toad, ugly and venomous,
Wears yet a precious jewel in his head."

Yours faithfully,

Dec. 1, 1944. "ENO."

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

The Balloon Barrage

Gas Industry's Great Part

The unprecedented demand for gas for barrage balloons reached its peak some months ago, and the outstanding part played by the Gas Industry throughout the war in connexion with this branch of defence may now be recorded. From time to time since 1939 much rearrangement of plant and concentration of effort were necessary to cope with R.A.F. requirements. Various gas undertakings strained their resources to the utmost to maintain the output of hydrogen at a very high level at all times.

Thanks to collaboration between the Industry and the Air Ministry, we were able last week to visit and inspect a typical plant at a gas-works in Southern England where hydrogen has been produced and filled into cylinders for supply to balloon centres and sites. It was, as a matter of fact, the works where the pioneer plant of its kind was operated. From our investigations we were able to ascertain many interesting facts, which can now be given for the first time.

The flying of a balloon barrage requires hydrogen far in excess of the quantity normally obtainable from industrial sources, except for a few special industries which use hydrogen or produce it as a by-product. Broadly speaking, these industries are all concentrated in the North of England.

The hydrogen has to be compressed into cylinders and transported by road or rail to the balloons. The expansion of the balloon barrage from 1940 onwards created a very heavy demand for hydrogen in the South and East. Consumption is greatly increased during periods of intense enemy activity, due to loss or puncturing of balloons, and in the second half of 1940, when the attack on Southern England was at its height, the limit imposed by transport from the North was reached. It became necessary as an emergency measure to fly at times with some coal gas in the balloons, at the expense of some loss of operational efficiency. To meet this shortage and to cover the further expansion of the balloon barrage, it was necessary to create at short notice a new source of supply for which the requirements were:

(*a*) Dispersal to decrease the risk of damage by enemy activity.
(*b*) The location of factories near to the using centres to reduce the transport problem to a minimum.
(*c*) Flexibility of output to meet the fluctuations in demand resulting from enemy action and weather.

Expansion of the Supply System

In September, 1940, a Directorate of Hydrogen Production was set up within the Air Ministry to review and consider plans for expanding the supply to meet the new conditions which had arisen. It was decided to seek the co-operation of the Gas Industry and, in addition to the plants already under construction at gas-works, to build many more of a smaller type with a greater degree of dispersal and situated with reference to the barrages as then planned. The final planned output, after writing off output not available on account of war risk, was 40,000,000 cu.ft. of hydrogen per week, of whicha pproximately 25,000,000 cu.ft. would be supplied from gas-works.

Technical Aspects

The hydrogen is produced at gas-works by the steam-iron process, using water gas and steam which are normally available. The water gas is passed over a heated chamber containing a special iron ore, which is reduced to iron. Steam is then passed through the ore and is in turn reduced to hydrogen. These operations continue alternately, and the hydrogen is collected, purified, and compressed into cylinders.

Progress

The first of the plants at gas-works went into operation in September, 1940, and others came in at regular intervals up to the middle of 1942. The quantity supplied from the Gas Industry in the years 1940 to the end of September, 1944, was 1,773,000,000 cuft. As a result of the decreased enemy activity the maximum expansion of the balloon barrage was not reached, and there was a general tendency to reduce barrage protection in the North and West, and to concentrate it in the South and East. As a result, an increasing proportion of the total load was taken over by the Gas Industry. The following table shows the quantity supplied in each year from the Gas Industry and from other sources, including Government establishments. Factories were put into production, or production was suspended, according to the operational requirements.

Hydrogen Supplied to Balloon Barrage.

Year.	Production at Gas-Works.	Others.
1940	43,060,440	545,510,249
1941	304,906,600	434,380,900
1942	452,193,900	316,248,600
1943	541,764,600	265,567,900
1944 (9 months)	431,806,800	157,602,000
	1,773,732,340	1,719,309,649

"D" Day

Balloon protection on a very heavy scale was provided for the operations before and after "D" day. In order to reduce congestion on the roads a maximum output was called for from the two stations on the South coast, and reserve supplies were drawn from the factories nearest to the South coast.

Balloon Barrage and the Flying Bomb

At the same time as the preparations for "D" day, plans were being made for a limited barrage to be used against the flying bomb. The first successes scored by the barrage resulted in the immediate withdrawal of balloons from other parts of the country, and ultimately for the concentration of the whole balloon strength into the barrage South of London. The area concerned was one which had not been covered by factory production, firstly on strategic grounds, and secondly because it had not previously required any heavy concentration of balloon barrage strength. It therefore became necessary to call for the maximum output from all factories in the London area, as the time and distance involved made it impossible to spare cylinders to bring in supplies from the industrial sources in the North. During one week when the demand was at its peak, two factories reached outputs 2½ times their normal rating, and several others maintained output at nearly twice their normal rating. The total consumption of hydrogen during the ten weeks of deployment of the barrage was 179,000,000 cu.ft., of which 140,000,000 cu.ft. was supplied by the Gas Industry.

The R.A.F. returns Thanks

At an informal ceremony in connexion with our inspection of the plant, thanks to the Gas Industry were expressed by Air-Commodore P. L. Lincoln, D.S.O., M.C., Deputy A.O.C. Balloon Command.

It was realized, he said, at the beginning of the war that hydrogen was literally the "life blood" of a balloon barrage, and that a sound working scheme was necessary in order to ensure that gas was always available to meet violently fluctuating demands sometimes at difficult and inaccessible places. Demands for hydrogen throughout the five and a half years of war had been often sudden and awkward, as wss exemplified by breakdowns in plants due to enemy action, replacements of heavy balloon casualties which had occurred in a particular area due to gales, sudden priority commitments, such as balloon protection for the invasion of the Continent, defence against the flying bomb, or the deployment or extension of a barrage around a vulnerable point.

Commencing in September, 1939, with large scale improvization, a distribution control system was gradually evolved whereby the limited number of cylinders available at that time were re-compressed and "turned over" as economically and as quickly as possible. At that time the only hydrogen supplies available were those which had been used in the airship days, and these were quite unable to cope with the alarming rising demand. Production eventually became the province of the Director of Hydrogen Production, Air Ministry, who, by 1941, had successfully mastered the situation by providing a hydrogen supply for a large number of plants at gas-works to meet any enemy action which could be reasonably envisaged. The aim of the organization was to consider a hydrogen factory as being analogous to a "running tap," for which a succession of receptacles (the cylinders) must always be available or waste and stoppages would occur. A scheme of daily allocation of trailers to works was inaugurated as essential to the maintenance of even output, economy of transport, and essential high reserves of compressed trailers. In spite of the large increase in the number of plants involved in the network of distribution, the scheme, with minor modifications, continued successfully through all phases of the operations. At its peak, nearly 30,000,000 cu.ft. of hydrogen was collected and distributed in a week.

At one period early in the war it was realized that, owing to increased consumption and shortage of motor transport and to the risk of danger of enemy action to the gas plants then in production, a shortage of hydrogen was a distinct possibility. Experiments were therefore performed of inflating a standard barrage balloon with varying percentages of coal gas. These experiments showed that, while operational efficiency was impaired, it was possible to fly a balloon with an admixture of coal gas and hydrogen. With new hydrogen plants in production requirements were well covered, and thereafter coal gas was to be used only in emergency. As a matter of interest, it was realized that the employment of coal gas necessitated the introduction of some form of percentage oxygen meter to determine the point at which the hydrogen coal gas mixture with air became dangerous. An instrument designed at a gas-works eventually became the standard purity meter for the barrage.

An R.A.F. detechment was located at each gas-works to deal generally with the vehicles and airmen arriving. These detachments carried out a routine job, and in every case the relationships with the managers of the works and the civilian employees were excellent, and too much emphasis could not be laid upon the co-operation and the many kindnesses extended by the staffs of these works to the service detachments.

Throughout the whole life of the Command it could be said that the

successful deployment of barrages, replacements of barrage casualties, or the provision of barrages for special commitments, such as the invasion of the Continent or the defences against the flying bomb, had never been affected by lack of hydrogen. In fact, it might be truthfully said that they were only possible because of the ready availability of the gas. Invariably the problem in emergency had been not to obtain the gas but to devise the most rapid method of collection, which has been essentially a problem of traffic movement control.

The opening of the Second Front on the Continent involved a very large balloon commitment in the protection of the beaches, captured ports, invasion craft and ports of embarkation, involving inevitably an extremely large hydrogen commitment. Throughout the whole operation the plants worked faultlessly and, in so far as hydrogen supplies were concerned, the whole operation was performed in almost a routine fashion. Coupled with the provision of a hydrogen plan for the invasion of Normandy, a plan had to be prepared simultaneously for the provision of a "curtain" of some 500 balloons in the event of attack by the flying bomb. The fact that the advent of the flying bomb did not coincide with the invasion operation very considerably simplified the problem of the supply of hydrogen for the "curtain" barrage. In due course, owing to the success of the balloon curtain, the number of balloons employed in the barrage was increased to nearly 2,000. The gas-works throughout the country made a splendid response to the large increase in the consumption of hydrogen which this barrage entailed. At no time during the "curtain" operation did the hydrogen supplies break down. "Hydrogen was always there," but it was only made possible by the tremendous zeal shown by all concerned, especially the employees of the gas-works from which supplies were drawn.

Teething Troubles

The RESIDENT DIRECTOR of the works at which the plant was inspected said that they were all extremely gratified when they heard that the Air Ministry had chosen their works for their initial full-scale plant. Knowing that it was a pioneer plant they expected a good many teething troubles, and in that they were not disappointed. Thanks, however, to the efforts of the technical staff of the contracting firm who had had experience with the small "pilot" plant on which the design of the full-scale plant was based, and also to the untiring efforts of their own technical staff under their chief chemist, the initial difficulties were overcome reasonably quickly, and they were able to evolve an operational cycle that was efficient both as regards the volume of water gas used per 1,000 cu.ft. of hydrogen made, and, what in the early days was very important, in securing a long life for the iron ore.

They liked to think that the results of their work in those early days had been of real assistance to the Ministry in the many other plants put up by them throughout the country. It was the result of the work of a splendid team of men and women—chemists, hydrogen operators, engine drivers, compressor men, cylinder charging attendants and water gas operators—all of whom had worked enthusiastically throughout, and without whose willing co-operation, often under most difficult conditions, good results and reliable working could not have been attained.

The speaker next paid tribute to the spirit which had animated the hydrogen staff consistently. They had been proud of their job and they had done it well. There had been times when bombs were falling around, one raid in particular when bombers were overhead for two hours with flares lighting up the whole area, and yet throughout those trying periods they stuck to their instructions minutely, shut down their plant calmly and quickly, and were as quickly on the job again without waste of time immediately they were told to resume.

As an example of teething troubles, the speaker mentioned that in the early days it was not appreciated that the compressed hydrogen in passing through the loading hoses generated a small amount of static electricity that accumulated in the metal cylinders on the lorry, insulated as it was by its rubber tyres. In the middle of one night shift a charger attendant, hearing the hiss of escaping hydrogen from one of the cylinders on a loading lorry, brought along a spanner to tighten up the connexion. Unlike the lorry, *he* had no rubber tyres on and so was *not* insulated, and the resulting spark from his spanner to the cylinder set the hydrogen ablaze. The whole load of cylinders was at that time charged with hydrogen at some 3,000 lb. per sq. in. pressure, and the man might have been pardoned for feeling worried. Not a bit. There were fire extinguishers provided for that purpose, so they were brought into use, but alas, without effect, the hydrogen being under so high a pressure that it just blew the extinguishing liquid aside and continued to burn. So the next step was to sacrifice all the hydrogen in the cylinders by blowing to waste through a valve on the charging panel. Then all was well. But it must have been an anxious time for the man, and he certainly deserves full marks for his calmness and presence of mind.

Reference had been made to the very heavy calls upon hydrogen plants, particularly in the South, for the balloon barrage during the time of the flying bombs. Again he would like to pay tribute to the men of the plant for the way in which they kept going every scrap of plant, every generator, every gas engine, every compressor, 24 hours a day every day in the week for several months on end without a single breakdown. It was a splendid record. Many urgent calls had been made upon them since they started work, and he felt he was justified in claiming that they had never once failed to deliver the goods. The credit went to no one man; it had been good teamwork throughout.

Air-Commodore Lincoln had been good enough to thank the Gas Industry for the help they had given to the Air Ministry. The Gas Industry had in their turn to thank the Air Ministry for the very valuable help they were giving them. The Gas Research Board had some most interesting and promising research work in hand on the hydrogenation of coal. This research had now reached a stage where a semi-works scale plant was necessary, together with regular supplies of high-pressure hydrogen. The Air Ministry had, through the very sympathetic help of the Director of Hydrogen Production, made it possible to utilize the Ministry's hydrogen plant not only now, and for several months past, but for several years after the war, if necessary. That was an action for which the Gas Research Board were very grateful. He was sure his words would be endorsed by the whole of the Gas Industry of Great Britain.

Mr. A. E. SYLVESTER (Chairman, Gas Advisory Committee) said it was his duty as spokesman to receive and acknowledge the thanks expressed by the Air-Commodore. In times of peace there was a popular slogan in the Gas Industry—"Gas never lets you down"; but they could now add to this a new slogan—"Gas Kept the Balloons Up." This was indeed an honour—a battle honour—of which they might well be proud in years to come. The Air-Commodore had referred to the work of the Director of Hydrogen Production, an office which was in the first place held by Lord Ridley. It was a matter of interest to the Gas Industry, and particularly to him, that he was succeeded in that work by Mr. W. K. Hutchison, who was lent to the Air Ministry by his Company. He was glad to see Mr. Hutchison there that afternoon, but hoped that before long he would be back with the Company again.

That afternoon a corner of the veil had been lifted, and part of the contribution to the war effort made by the Gas Industry had been disclosed. But there was a great deal more yet to be told, and when the veil could be entirely removed it was certain that the public would be astonished at the work the Industry had done.

In closing, Mr. Sylvester acknowledged the splendid work performed by those responsible for the work of the balloon barrage. Southerners —and he spoke from personal experience—knew how much worse things might have been during the flying bomb attacks last summer without that last line of defence of balloons. This war had shown how much they were dependent upon each other, and if they could carry that realization into times of peace, it would go a long way towards solving the difficulties with which they would be faced.

Inauguration of British Coke Research Association

On Wednesday last a Conference was held at the University of Leeds to mark the inauguration of a new research organization, the British Coke Research Association, a body formed by the British Hard Coke Association, which is practically 100% representative of the coke oven plants in the United Kingdom. Supported by a financial grant from the Department of Scientific and Industrial Research, B.C.R.A. joins the growing number of State-aided Research Associations. The conference last Wednesday enjoyed a large attendance, was full of hope and enthusiasm, and constituted a most happy "send-off" for the new body.

Following a welcome to the University by the Vice-Chancellor, Mr. MOUAT JONES,

Mr. RALPH ALSOP, Chairman of the Association, explained that the constitution of the Association met with the approval of the D.S.I.R. in June last, and it would co-ordinate the work previously undertaken by the Midland, Northern, and Scottish Coke Research Committees. Since the present war the hard coke industry had been organized on a national basis, and it quickly became clear that there ought to be a national organization for research. The Association, which aimed at the elimination as far as practicable of the overlapping of research, was really the result of suggestions put forward by Sir Harold Hartley, Chairman of the Fuel Research Board, and to Sir Harold and also to Sir Hubert Houldsworth, Controller-General at the Ministry of Fuel and Power, they were extremely grateful for their help and sympathy. They were gratified, too, at the complete support of the coke oven industry. A Council of the Association had been set up; the regional committees would be there to advise; and a programme committee had already put forward its suggestions. Panels had been formed to deal with specific subjects, and in the work they had enjoyed the wholehearted co-operation of the Coke Oven Managers' Association and of the coke oven construction firms. Centralized activities would go hand in hand withreg ional activities, and the coke oven industry as a whole would be made acquainted of the results of the various researches. The results would be passed on promptly to the industry, and it was felt that the Association would prove a vital factor in the industry's development.

Sir HAROLD HARTLEY, having referred to the lively interest which the D.S.I.R. had always taken in the work of the Research Committees, welcomed the new Association. Advantages were sure to accrue to the industry by bringing the work under general direction and by having greater financial support. He regarded the coke oven industry as one partner in a great carbonizing industry, the other partner, of course, being the Gas Industry. In a chemical age, both gas and coke meant so very much to the nation as suppliers of raw materials for chemical industry; and the coke oven industry and the Gas Industry had common interests and common problems. The Association had certainly been formed at an opportune moment. Surveys of resources and surveys of consumption of fuel were all-important. There was no doubt that the Fuel Research Board's Coal Survey had contributed largely to the national war effort, and it was hoped that early in 1945 it would be possible to pass from the qualitative to the quantitative aspect of the work, the importance of which could be gauged from the fact that in 1938 the expenditure in fuel and power amounted to no less than 10% of the national income. The British war effort had been dependent on the spirit of the people and on co-ordinated effort; it had also been dependent on scientific research, and the establishment of the Association fitted in with the new conception of the scientific plan.

Sir HUBERT HOULDSWORTH, K.C., having referred to the interest taken by the Mines Department in the British Hard Coke Association, said that modern war focused attention on the contributions of science and of the men trained in science. After the last war several research associations were formed, but the support given to them was inadequate. If we intended to succeed in peace, we must harness science and industry more firmly and more effectively. The ravages of war would have to be restored; we would have a difficult transition period from war to peace and we should have to recapture our export markets. To restore prosperity there would have to be a complete mobilization of science, pure and applied. The time was opportune for the formation of the British Coke Research Association, a body dealing with a fundamental national asset, and the Ministry of Fuel and Power offered it a warm welcome. He suggested that it would be folly to expect "get rich quick" results from the research; they must exercise patience while allowing the maximum freedom of thought and action. And he trusted that the Association would walk in step with the universities which were carrying out fundamental research.

Dr. E. W. SMITH, President of the Institute of Fuel, welcoming the Association on behalf of the Institute, said that research associations existed to make industry more efficient. They existed to make money; yet fundamental research should come first. He hoped that the Gas Industry would agree to a maximum collaboration with the new body, and he appealed to both sides of the carbonizing industry to work on joint panels. The research associations had, he thought, been a great success, but there was one very important factor—and that was the question of research administration and direction. It seemed to him that too many members of council of research associations were actually engaged on work of the same type as was being undertaken by the associations themselves, and this did not result in the free pooling of experience. It was, he thought, a matter to be remedied. There was just one more thought. He hoped the Association would encourage its director in research, and would leave the aspect of publicity to some other section.

Dr. A. PARKER (Director of Fuel Research, D.S.I.R.) said they were anxious at the Fuel Research Station to assist in the work of the Association, and he was sure the best results could come only from full co-operation of the research men engaged in similar fields of work. There could well be, he suggested, a pooling of staffs and resources.

Professor D. T. A. TOWNEND (Livesey Professor) read a contribution from Dr. J. G. KING (Director of the Gas Research Board), in which Dr. King expressed the strong interest which the Gas Research Board has in the fortunes of the British Coke Research Association. "Research on coke," he wrote, "forms an important section of the programme of the Gas Research Board. It will include problems of production, crushing, sizing, the modifications of important properties such as reactivity, and possibly variations in production technique to make coke a more flexible fuel or applicable in wider fields. It will also include problems of coke in special and non-special appliances in both domestic and industrial fields. . . . There must be many parts of the pattern of research on coke which have common interest for the gas and coke industries. If we do agree on this, we must prepare our research programmes not separately, but in that spirit of collaboration which will obviate any unnecessary duplication of valuable research effort. We are both young organizations, and it is in the early days of our expanding effort that this collaboration must be brought about. . . . Representation on one another's sub-committees, say by the respective directors, might be a wise first move." Expressing confident hope for the most cordial relations between the G.R.B. and the B.C.R.A. and complete collaboration in any common aim, Dr. King added: "These aims are not, of course, confined to coke, since both gas and benzole also present common interests. I believe that these do not yet come within the terms of reference of the British Coke Research Association, but, as we are the Research Association of the British Gas Industry and cover all subjects in that Industry, I hope that you also will come to cover all subjects in yours, and that a research pattern can be woven to serve both our interests."

Mr. E. C. EVANS said he regarded the inauguration of the Association as in the nature of a coming-of-age of a body conceived by the late Professor Wheeler and himself. The Midland Coke Research Committee was the first to be formed, followed by the Northern and more recently by the Scottish. In the work of these committees the coke oven managers and the blast furnace managers had co-operated; and as a result of the work there had in the present war been nothing like the deterioration in coke quality which occurred during the last war. The Association had great work to do. Coking coals represented a most important national asset, and their efficient use would have a profound bearing on the national welfare.

Thereafter Professor H. L. RILEY, Honorary Director of the Northern Coke Research Committee, gave a lecture, illustrated by lantern-slides, on the "Genesis of Coking Coals." A vote of thanks to the lecturer was proposed by Mr. E. HARRISON, President of the Coke Oven Managers' Association, and this brought the conference to a close.

Eastern Counties Association

The Autumn Meeting of the Eastern Counties Gas Engineers' and Managers' Association was held at Grosvenor House, London, on Nov. 30, the President, Mr. W. J. Collins Garrard (Ipswich), presiding over a good attendance of members. In welcoming several visitors, including Mr. S. E. Whitehead and Dr. W. T. K. Braunholtz (President and Secretary of The Institution of Gas Engineers), Mr. Kelf Cohen (Ministry of Fuel and Power), Mr. Marsh (Eastern Regional Controller), and Dr. A. J. V. Underwood (Joint Hon. Secretary of the Institution of Chemical Engineers), the President referred to the disappointment caused by the cancellation of the spring meeting through circumstances beyond their control, and the fact that he had had to be content with issuing his Presidential Address without presenting it in the usual manner. In the course of that Address he had said: "Any industry which is to survive must evolve, but I am impressed with the fact that the Gas Industry simply cannot afford to wait for large scale changes in organization and production methods which are envisaged by the planners. We must have a 'Target for To-day' as well as planners for to-morrow. . . . Let us see to it that the uncertainties of to-morrow do not dim the opportunities of to-day." Let them have research by all means, but he begged the Industry not to wait too long for new plans. They must keep themselves as efficient as possible, and they must admit that their present system of gas-making was not too bad. He was not one of those who held the view that the Gas Industry never had been any good. They had given a wonderful service in the past, and with the help of their research workers they would continue to do so in the future. Mr. Garrard added that his Chairman, Mr. Woodall, had attended at geat inconvenience, but had had to leave before the proceedings opened.

The President referred to the death during the past year of Mr. J. Baldwin, Mr. A. Bell, Mr. A. E. Broadberry, and Mr. F. Prentice, and the members stood in silence as a mark of sympathy.

Six new members and one associate were elected as follows:—Members: B. T. Comins (Framlingham), D. M. Gibson (Baldock), H. R. Thomas (Bury St. Edmunds), R. C. Wardell (Boston), H. R. Warring (Haverhill), and P. Wedgwood (Watford). Associate: A. L. Croager (Kenton).

The President presented a silver inkstand, suitably inscribed, to his predecessor in office, Mr. L. C. B. Williams (Thetford), in token of the members' appreciation of his services in the chair. He said Mr. Williams had been a very popular President and did his job thoroughly well, including the presentation of an extremely interesting and well-prepared Address. They looked back with pleasure on the year in which he presided, and remembered with perhaps a little envy the dignity with which he filled his high office.

Mr. Williams, in a brief reply, said the presentation would recall happy memories, not only of the meetings, but of the many friendships made during the year.

The President announced that Mr. H. E. S. Birks had been successful in gaining The Institution of Gas Engineers' Higher Grade Certificate in Gas Engineering and Supply. Mr. Whitehead had hoped personally to make the presentation, but in the absence of Mr. Birks the certificate would be forwarded to him.

The distinction of Honorary Membership of the Association was conferred on Mr. J. H. Troughton (Newmarket) and Dr. E. W. Smith. Warm tributes to their work for the Gas Industry were paid by the President, Mr. R. Prince (Peterborough), and Mr. F. Allen (Clacton).

Mr. Troughton, in acknowledging the honour, said he joined the Association 54 years ago, was elected to the Committee shortly afterwards, and had been in harness ever since. At the end of his presidency he was interested in forming the Eastern Counties' Commercial Section, which did very good work, and out of it arose a Tar Committee and a Coke Committee. He had known every one of the 50 Presidents of the Association, and without invidious distinction he could say they were all eminent men and did wonderful service in various ways. One of his own early recollections was that of a deputation to the Home Office, led by Sir Daniel Ford Goddard. There was an idea

that tar was in some way the cause of cancer, but the leader of the deputation talked to such an extent about tar that after they came away they heard nothing more about the subject. One of the best things he had done for the Association was to persuade Mr. Redwood to become Secretary and Treasurer. They now had 107 members against the 20 when he joined, together with 44 Associates. Good work had been done, but there was still much more to be done in the future.

Dr. Smith said the Eastern Counties' Association had always shown him affection, loyalty, and support as had other District Associations. In the early days the Association nominated him for the Council of The Institution of Gas Engineers, and he was one of a small committee of three appointed to decide what the future organization of research should be. It was touch and go, and after consultation with the other two he drew up a report which was presented to a small committee of the Council. He was unable to attend the meeting at which it was considered, and when he arrived later he found it had been turned down, but he persisted in asking why the recommendations could not be accepted, and in ten minutes they decided to have a research organization. Someone had said that his appointment at the Ministry of Fuel and Power was the culmination of his career. So far as activities were concerned it was probably just the beginning.

Election of Officers

The following officers were then elected for the coming year: President, J. Hunter Rioch (Cambridge); Vice-President, F. N. Howes (Chelmsford); Representative to the Council of The Institution of Gas Engineers, J. Hunter Rioch; Auditors, J. H. Troughton (Newmarket) and H. R. Wimhurst (Bury St. Edmunds); Education Secretary, R. C. Wardell (Boston); Hon. Secretary and Treasurer, H. H. Redwood (Newmarket); members of Committee, R. Prince (Peterborough) and C..G. Grimwood (Sudbury).

Mr. J. Hunter Rioch, returning thanks for his election as President, said the last time they elected a Scotsman was in 1917, when they chose Mr. Terrace, and it was 33 years since the Cambridge Undertaking was represented in the chair by Mr. Auchterlonie. He was happy to say that he was requested by his Chairman and Directors to invite the Association to meet at Cambridge some time during 1945, by which time he hoped the war in Europe would be ended. He was also pleased to say he had received a telegram from the staff at Cambridge congratulating him on his appointment and wishing him a happy year.

On the motion of Mr. J. Terrace, seconded by Mr. J. H. Troughton, the meeting voted its usual donation of £30 to the Institution Benevolent Fund. As Chairman of the Fund, Mr. Whitehead thanked the Association for its support.

The President reported that there had been no calls on the President's Benevolent Fund during the year.

Dr. F. J. Dent, Joint Assistant Director of the Gas Research Board, then presented a summary of his Paper on "The Production of Gaseous Hydrocarbons by the Hydrogenation of Coal" (already published in the "JOURNAL"), and Dr. J. G. King, Director of the Gas Research Board, gave an informal talk on "Research in the Gas Industry." Dr. King's discourse and the discussion on Dr. Dent's Paper will be dealt with subsequently.

At the close of the discussion, Mr. Hunter Rioch moved a vote of thanks to the President for the admirable way he had carried out his duties during his year of office. Reference had been made by more than one speaker to the admirable Presidential Address which Mr. Garrard had circulated. He would only add that he had found it full of interest and had read it more than once.

The President briefly replied.

The British Standards Institution announces the publication of a *Handbook for Building Materials and Components* which includes essential technical data from 164 British Standard Specifications. This Handbook has been issued to serve as a supplement to the *Housing Manual* recently issued by H.M. Government, and the Standards will be used as a basis for post-war building. It is therefore indispensable to architects, engineers, local authority officers, builders, builders' merchants, and manufacturers of the great variety of materials and components who will be concerned with this urgent national problem. Copies can be obtained on application to the offices of the British Standards Institution, 28, Victoria Street, S.W. 1, price 12s. 6d. post free. (317 pages.)

The Trustees of the Nuffield Foundation have offered the Universities of Manchester, Durham, and Glasgow grants totalling £150,000 to assist them to carry out schemes which they have submitted for the development of teaching and research in industrial health. The grants will be spread over a period of ten years. Manchester University, where it is proposed to create a Chair of Industrial Health—the first full professorial department of the kind in the country—will receive £70,000. Durham University will receive £40,000 for the establishment of a department under a university reader, and a similar amount is being allocated to Glasgow University towards the creation of a sub-department of Industrial Health within the existing Department of Social Medicine.

Why the Fuel Technologist is Essential

The important role to be filled by the fuel technologist in the post-war world was outlined by Mr. P. C. Pope, Secretary of the Institute of Fuel, in a talk on "Why the Fuel Technologist is Essential" to the Fuel Luncheon Club last Wednesday. He reviewed the serious decline in coal output in recent years, and asked how were the requirements of the industry to be met if we were not able to increase the output from our collieries very materially?

A great deal had been done during the war through the Fuel Efficiency Campaign inaugurated by the Mines Department, and since carried on by the Ministry of Fuel and Power, to improve the thermal efficiency in many of our industrial plants, and a great deal more could have been done had there been more trained and experienced fuel technologists available, and if the plants under their control had had more modern combustion equipment. Most of the economies obtained through the medium of these fuel technologists had been the prevention of, to them, obvious waste, but given sufficiently suitably trained technologists of different types, their knowledge, if properly applied, could even now save at least twenty, if not thirty, million tons of coal per annum, but they must be allowed to spend a reasonable amount of capital to modify existing equipment, or, where needed, install new equipment. If this was not done and the output of coal was not materially increased, industry would not be able to maintain the output of manufactured goods necessary to provide even our home needs, let alone export, and find employment for everyone in the country.

The technical man was not the only one in a works who could save fuel. A very great deal could be done by the management and administrative people applying common sense in arranging timetables for the use of process steam, seeing that furnaces were properly loaded, motors not left running idle and so on. For instance, in a certain army canteen, open day and night, where all the cooking was done by gas, it was found that over 90% of the meals were served in two periods of one hour each. It was then arranged that the canteen should only serve meals for two hours in one part of the day, and for another two hours later, with the result that the consumption of gas was reduced to one-third of what it had been previously.

In his opinion three classes of fuel technologists were needed: (1) Fully trained, with fundamental knowledge of design, men capable of undertaking research and experimental work having a practical objective, and competent to act as consultants on fuel problems ; (2) men with practical experience of plant control and operation, not necessarily designers of equipment, but capable of criticizing designs submitted to them, keeping records and carrying out tests, and who understand and appreciate the use and value of control instruments; and (3) operators who are each trained to control and maintain the particular kind of furnaces under their control, such as boilers, steel furnaces, blast furnaces, glass tanks, gas producers, and so forth. These men would be provided with instruments, the operation of which they need not understand, but they should know what any movement in an instrument indicated, and be trained to act accordingly.

To be effective all these classes of men must be paid adequately for their labour and skill. This was not a matter which could be left to look after itself. It was one which called for resolute action, and it seemed to him that the first step in that direction was to set up qualifying standards for all classes of fuel technologists, and to do this in such a way that students, operatives, furnace-men, and charge hands concerned with the use of fuel could be given adequate training and instruction, which would lead in many cases to the fuller training of the fuel technologist proper.

The Ministry of Fuel and Power did a good job in the arrangements its Education Committee made for the instruction of fuel users in industry. It organized courses of lectures and demonstrations in the economic use of fuel in over 120 centres, and some 20,000 men had attended them. This was a wartime measure, but the results had justified the setting up of more permanent and maybe more extensive courses of instruction and training in these matters in the post-war world. He wondered if this would be done, and if so, by whom. It was impossible to overstate the importance to the national welfare in the future of securing to industry an adequate supply of graduate fuel technologists, fuel technologists other than those who had obtained their theoretical qualifications by means of full University courses, and industrial operatives with specialized training in the practice of fuel technology. Such a body of men could save industry not only a large amount of money by reducing the cost of manufactured articles, but in many instances also by improving the quality of those articles. Their work would steadily grow in national importance under the conditions which would shortly arise, for unless the coal output was very largely increased, about which most people had grave doubts, it would only be through their efforts that the industries of this country would be able to function at full blast.

The Accounts of the Metropolitan Gas Company of Melbourne for the year to June 30 just to hand show a profit of £170,954, compared with £157,615 for the previous year, and a final dividend of 5s. per share, the same as before, leaving £90,952 to be carried forward, against £84,998 brought in. The operating results for the year show that 418,114 tons of coal was carbonized, 7,157 million cu.ft. of gas was made, producing 278,277 tons of coke, 7,156,836 gallons of tar, 1,425 tons of sulphate of ammonia, and 1,560,700 gallons of ammoniacal liquor.

Evolution in Fuel Supply*

By J. E. DAVIS, South Metropolitan Gas Company

I OFFER you a paradox. Here is its first side. The quantity of energy required to warm and light the normal home, to cook the food of the family, and to provide an ample supply of hot water for one year does not exceed that obtainable from 1 ton of coal. Before the war this 1 ton of coal could be purchased as part of a bulk delivery to most towns for about £1. Here is the other side. The amount of coal used to provide these services (and then not always adequately) was between 5 and 6 tons, and the cost of these services between £16 and £17.

Within the limits of this paradox lie the foundations of two-thirds of the Gas Industry, one-third of the electricity industry, all of that industry which makes and supplies domestic fuel appliances, and the prospect of many proposals for heating by the transmission of steam or hot water.

You will observe that on both sides of the paradox there are two factors; one of them technical, concerned with quantities of fuel and quantities of heat, and the other one economic, concerned with the cost of the raw material and the cost of the service.

My theme is that throughout the domain of fuel supply factors of these two kinds rule, and by their interplay determine the form of day-to-day procedure and of future development. Though differing in kind they are inseparable, and considerations of either kind alone will solve hardly one of our many problems.

You may say that the paradox is incomplete because it makes no reference to many important issues. That is true. Atmospheric pollution, the winning of secondary products by the treatment of coal, the handling and storage of fuel and the time given to attendance upon fuel-using equipment, are all important issues not covered by the simple statement of that paradox. But if we elaborate the issue by bringing in these considerations, we see that each one of them also has technical and economic aspects again completely interwoven. The production or non-production of smoke is a technical issue; but the consequences of smoke are economic. The obtaining and refining of secondary products is a technical matter, but their importance arises from their contribution to the national economy. The handling of fuel and the labour associated with its use are matters to be dealt with by technical means, but they have economic importance even though it may be impossible to put a money value to the labour of the housewife.

Now, if we are to resolve this paradox and deal rationally with the attendant issues we must surely adopt a procedure which will keep both technical and economic factors constantly in view, and it would be folly to think that we can solve problems on one or other ground alone. If I add to that statement the suggestion that we must approach the problems of the fuel industries from a scientific standpoint, you will no doubt conclude that I am contradicting my own argument. May I submit that this is not the case.

I believe that there is too often a tendency to stress the difference between the scientific worker or technician and his colleague with a business or so-called "practical" training; a tendency which can do immense harm to science and the appreciation of the scientific method.

Science and Scientific Method

You will notice that I have drawn a distinction between science and the scientific method. The word "science" itself means no more than "knowledge," but it is reserved for that body of knowledge which has been accumulated by a particular discipline of thinking termed the "scientific method." Great as have been the material changes wrought through science, I believe that the greatest gift which science offers to mankind is the disciplined thinking which we call the "scientific method." And, be it noted, this method is by no means confined to chemists, physicists, and their kindred "ists" and "ologists." It is used in part and sometimes in whole by many who lay no claim to be scientists. This, if we understand it and appreciate it, should make it much easier than it often has been to bring together as a working team the individuals possessing the diverse talents which modern living requires.

The scientific method, applied either to a simple problem or to one of great complexity, comprises three definite phases. They are not necessarily separate phases, and they are certainly not independent of one another.

The first phase we may call "fact finding," the second, "hypothesis," and the third, "experiment." The procedure is to assemble certain observations or facts; to recognize in these facts certain patterns or relationships; to bring to bear upon these relationships one's imagination, and so construct a hypothesis to explain that relationship and give it reason; finally, to test and try that hypothesis by experiment in order to see whether it has value and validity in predicting new facts.

The collection and verification of the facts themselves is most times far from easy. Statements and figures may masquerade as facts when they are little else but fancies or prejudices. The scientist must test his facts, and in doing so he may have to adopt the processes of hypothesis and experiment. Moreover, when the facts themselves are established and tested it may be very difficult to see in them any pattern or order. The complex procedure of statistical examination may become necessary in order to reveal relationships. Now this part of the scientific method is widely employed by, among others, the accountant, the analyst, the statistician, and the composer of questionnaires.

Whether the facts and relationships so observed are to be used scientifically depends upon whether the next phase of the scientific method is applied. Only too often one meets the point of view that "Those are the facts and you can't do anything about them." But to the scientist facts and statistics are not dead things; they are the observable results of laws and forces actively operating, and when facts are known there is a lot he feels he ought to do about them. The facts may represent the result of something which has happened already, but he asks whether future events need be an exact repetition of the past. By understanding the laws and forces which produced these facts he endeavours so to control their operation that they may give rise to a different and more pleasing set of facts.

The Function of Imagination

It is to this end that the phase of hypothesis is so important. Here it is that the practical man of affairs most often loses patience with the scientific research worker. A moment ago this fellow was asking for precise figures, and being most fussy and meticulous about their accuracy and significance. Now he starts imagining things, apparently leaving the facts and entering the realm of fantasy. It must often look like this, for imagination is the essential factor in the phase of hypothesis; but it is not wild imagination. Certain relationships between facts have been observed in the first phase, and certain similarities and analogies suggest themselves according to the particular branch of science in which the worker has specialized. The structure built up in imagination must never go further than is warranted by the facts, or by other sets of facts brought in from analogous relationships. The process of imagining is not untrammelled, but is limited by the purpose for which it is called into being. On the other hand, the particular form that the imaginative exercise takes is highly individual. It is always useful and indeed necessary to have the power to recognize analogies and paradoxes, but the subsequent development from this recognition may take many different courses.

If imagination is allowed its play beyond the necessary limits or without judgment the penalty will be exacted in the phase of experiment. It is this phase which brings the scientist to earth again, for he has to subject the hypothesis built from his imagination to practical test,and it is his duty to devise every searching test that he can think of to disprove and upset the very hypothesis he has conjectured. This is a severe discipline against unwarranted assumption or fantastic flights of fancy, for such will surely lead to unsuccessful experiments and long periods of disappointment, but if the facts have been chosen, duly verified and correlated, if the creative imagination has been vigorous but disciplined, experimental verification may not be far away and the reward of a new piece of knowledge is obtained.

It is not to be thought that every forward step of this nature, however successful in itself, is startling. In fact, it mostly happens that after this seemingly lengthy and laborious process the new information does little more than confirm what many had previously suspected. The important feature is that it is confirmed. It is now known, and not guessed at.

We saw that the scientific worker was not alone in the first phase of collecting, verifying, and correlating figures. He has many colleagues. Neither is he alone in using his imagination and judgment in the second phase of hypothesis. Most of our industries were built by men who did similarly. Mercantile activities have this basis of recognizing the anomaly of a surplus in one neighbourhood and a shortage in another, and visualizing methods of reconciling available supplies with potential demands.

Checking by experiment is an inevitable step that all can understand, whether it is recognized as an experiment or termed the "hard school of experience." It is the reaction that raps all our knuckles for a mistake.

There is nothing to prevent the man who deals with facts concerning money entering the phase of hypothesis and experiment and so adopting the scientific method. There is nothing to prevent the merchant supporting his judgment and recognition of anomalies by the collection and correlation of facts and, indeed, we all know that to-day this is commonly done.

Why, you may well ask, am I so concerned to show that the scientist or technician and his way of thinking are not so essentially different from other men and their ways? It is because I believe that industry and in particular the Gas Industry, will only make its full contribution to the common good if the engineer, chemist, physicist, and economist can make each their special contribution in a united effort. The

* Paper to the London and Southern District Junior Gas Association.

paradox with which I opened these remarks will be resolved by no one of them alone.

Industry is primarily a technical achievement. Its success in contributing to the common good is a matter of economics. A chemical industry such as our own is conceived in the mind of the chemist, given form by the engineer, but grows and develops, or is restricted by the economic circumstances which result from its operation. Evolution in fuel supply will demand the close study of technical factors and their economic results. The economic results may well show weaknesses in technique, and call for further development and application of engineering or chemical principles to amend the economic result. Let us look at some of the departments of our own Industry, and note the inter-relation of these two kinds of considerations.

Inter-relation of Methods of Approach

For the utilization of fuel it is necessary to design and provide appliances. In their design, chemical and physical principles are involved. In their production engineering problems arise and require solution. A close understanding of these principles may lead, and usually does lead, to increases in thermal efficiency, or in efficacy (that is, the efficiency of the appliance in doing its specific job), or to greater ease of production, longer life or less maintenance. All such developments will receive their final evaluation in economic terms; in the saving of fuel, in better control, or saving in time or labour, and in the initial and overall cost of the appliance. A balance has to be sought between the first cost of the appliance, the overall cost of the appliance taking into account the expenditure on maintenance during its life, and the running cost. The economic result may indicate that increased thermal efficiency has been obtained at too high an added cost for the appliance. The problem is then returned to the technician, who may agree to accept a lower efficiency or—what is more probable—will seek an alternative method of providing the improved result.

In looking at utilization we started from the technical end. Let us, in the distribution department, start from the economic end. It has been said that the greatest obstacle to a largely increased use of gas as a fuel is the high cost of distribution. Indeed, if one were to accept as the cost of distribution the total expenditure grouped under this heading in the returns of gas undertakings, this would appear a real difficulty. At pre-war values the cost would have been expressed as, perhaps, 3½d. a therm, but examination of the items which go to build up this cost soon reveals that many of them are in no way related to the number of therms distributed. Even apart from the big block of costs which is more properly termed "consumer service" than "distribution," the actual costs of physical distribution of the gas, particularly to domestic consumers, are not necessarily related directly to the number of therms sold. The distribution system of mains and service pipes is designed and installed to meet the maximum peak demand, and in normal existing practice the full capacity of the system is employed for less than 15% of the time. Distribution engineers know that the limiting factor to the capacity of a network supplying a large number of small consumers is the small permissible pressure drop along lengths of local main. They have shown this limitation can be removed by the installation of service governors, a proceeding which, at a cost insignificant with the cost of the mains system, trebles or quadruples its peak capacity.

In that specialized section of distribution, the bulk transmission of gas, large economic advantage has accrued not so much from technical innovations as by modifying the technique of transmission in the light of economic results; by the employment of storage at strategic points to improve the load factor upon the mains system, with the result that gas transmission to-day is economically possible in circumstances which would have been thought unreasonably costly only a few years ago.

In the manufacturing department there is a multitude of problems, ranging from the quality and availability of the raw material to the proportions and quality of the various products. The inter-relation of technical and economic factors in both of these two examples is obvious. Even though it may be no longer possible to select the raw material and balance quality against price, changes in quality have their repercussions throughout the manufacturing process, and increase or decrease the level of costs at every step. The proportioning of products, as reflected in the relative yields of gas and coke, is regulated by technical means to serve the economic end of balancing demands for these commodities.

It would be possible to develop this theme indefinitely, but that would be a far less useful occupation than considering how best we may order matters so that these various influences and consequences are kept under observation, control and direction.

Knowledge of Facts

We noted earlier that the scientific method depends primarily upon a knowledge of facts, and our Industry is sadly lacking in facts about itself. In regard to both technical statistics and costs, there is a very great lack of definition and of material. Perhaps the lack of definition is the first and most serious deficiency. Figures are of little value unless their meaning is clearly defined and understood. We saw that the traditional figure for distribution costs did not represent the cost of distributing gas. In the same way one may find that the cost of manufacture is not necessarily the cost of manufacturing gas, but is usually the cost of manufacturing gas, plus the cost of providing and maintaining plant and an organization to meet a short-lived demand for gas. Figures of yields from the manufacturing process may be interpreted in different ways by different undertakings and the results be non-comparable. What is breeze? When we speak of "number of consumers" how do we define a "consumer"? Numerical accuracy to several places of decimals is far less important in this matter than accepted and clear definition of the quantities represented.

Holder storage is recognized as an asset of very great value to the Industry, but there is little, if any, information to show how much holder storage is used to meet variations in hour-to-hour demand and how much to meet longer term variations in demand; for example, the variations from day to day over a period of a week or so. It will be very important to know the facts about this and similar matters, should the Industry accept such a proportion of heating business as would appreciably alter the present demand characteristics.

Demand Characteristics

How much attention has been given in the Gas Industry to demand characteristics? The electricity industry incurs much heavier capital charges in respect of both manufacturing and distributing plant per therm of maximum demand than does the Gas Industry. This has required the electricity industry to study closely the effect of diversity and coincidence of demand; a study which has not been made to any appreciable degree in the Gas Industry, yet will need to be made if the fullest value is to be obtained from the capital invested in manufacturing and distributing plant.

A gas cooker may represent a connected demand of 0.6 therm, but an after-diversity maximum hourly demand of less than 0.1 therm. (The after-diversity maximum hourly demand is the peak hourly demand per consumer after allowing for the fact that all consumers do not use their cookers full on simultaneously.) The after-diversity maximum daily demand is about 0.4 therm per consumer. These figures are of basic importance, for they determine the capacity of both the distribution and manufacturing equipment which has to be provided. They may be deduced from existing records with a fair degree of precision, but where are there comparable figures for the demand characteristics of a wash boiler, instantaneous or storage water heaters, or space heaters both flueless and flued in living rooms and bedrooms? Such figures may be deduced with a fair approximation to what is probably true by assuming certain customary methods of use, and even in this approximate form their indications are of value. But more accurate information is urgently needed.

Figures for demand characteristics require to be linked up with overhead costs of the manufacturing plant and equipment, and the organization for the operation of plant ready to meet these demands.

Figures I have quoted for the demand characteristics of the cooker load represent an hourly load factor of 12½%. To meet such a demand electrically would represent a cost of 1½d.–2d. per unit. Of course we know that such a high charge is not made, and that some relief in cost is experienced by reason of the fact that the domestic cooking load is in part off-peak to the industrial load, while some contribution towards the cost of electricity for cooking can be obtained from the price charged for lighting. It is, however, very questionable whether these reliefs would continue to operate if the amount of cooking that was done electrically reached a high proportion of the whole. Lower capital charges per therm, lower commodity cost per therm, and lower capital costs of distribution per unit of thermal capacity, combined with holder storage, enables the Gas Industry to face demand characteristics of this type with little concern.

The items of cost which go to build up the total cost of fuel service to the ultimate consumer are each determined by certain physical facts, and as long as these facts remain the same it is not possible to make, with normally good management, any great change in the overall cost. These unit items of cost may be grouped together according to the circumstances that control their magnitude, and when this is done it is possible to make comparisons between alternative systems of supplying the same or a similar service. This would seem to be the scientific method of deciding when and for what purposes it is most economically appropriate to use gas or electricity or solid fuel or district heating.

It is possible to do violence to such considerations and yet to continue to avoid the consequences for quite a while, but in the long run these forces will make their power felt, and if competition between the various fuel industries does not proceed along lines dictated by technical and economic principles the public will be the sufferer. Knowledge of the technical and economic factors of fuel supply, and of the changes wrought in economic results by technical advances, is the only sound guide to permanent progress either in our own Industry or in the fuel industries generally. It is also the only safe background to the development of markets and to methods of charging for the service supplied.

(To be continued)

They are looking forward to the time when they can once again exercise their skill in the preparation of lovely dishes. The cooker will be of prime importance and in this respect Parkinson intend to provide good cause for satisfaction.

Parkinson

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Manchester Juniors

A Meeting of the Manchester and District Junior Gas Association was held at St. Helens on Nov. 18. It was attended by nearly 200 members, who assembled at the Gas Showroom, Radiant House, where they were welcomed by Alderman W. Burrows, J.P., Chairman of the Gas and Lighting Committee.

After an inspection of the showroom, which was much admired, the members were conveyed to the Sherdley Works of the United Glass Bottle Manufacturers, Ltd. Here they were conducted over the works and given every facility for inspecting the manufacture of all kinds of glassware. The intricate and ingenious machinery in operation occasioned considerable comment, but the members were particularly interested in the manner in which gas was utilized in the various processes. It was particularly stimulating to find that gas played such an important part in a highly-organized and efficient works.

The Managing Director, Mr. Lomax, stated that the efficient service given by gas had enabled them to increase output many times above that previously obtained. He was very appreciative of the assistance and advice given to the Company by Mr. R. L. Greaves and his staff, and instanced the success that had been achieved by reducing the sulphur content of the gas to a negligible quantity, thus enabling the Company to market a better product. There is a catalyst sulphur extraction plant, and a benzole and sulphur extraction plant by activated carbon in the glassworks.

Subsequently members were entertained at luncheon at the Fleece Hotel on the invitation of the Chairman and members of the Gas and Lighting Committee.

The Mayor (Councillor G. Marsden), in proposing the health of the "Manchester and District Junior Gas Association," said one of the primary objects of the Association was to assist in the technical education of its members, and St. Helens was always willing to help in every way in such a worthy cause.

Mr. Alfred L. Holton, who is an honorary member of the Association, responded. He stated that he had been a member of the Association for 43 years, and he had watched its continual growth with great interest.

Mr. John Terrace (Honorary Secretary of The Institution of Gas Engineers) supported Mr. Holton. Although he had never been a member of a Junior Association he had always been interested in them, and he had been gratified to see the affiliation of the British Junior Gas Associations Joint Council to the Institution. He had always felt that the Institution should be as representative as possible of the Gas Industry. Now that the Junior Associations had a representative on the Council of the Institution, there was no reason why the members should not be more fully informed of the work that was being carried on in London. Some of the younger members were impatient regarding the delay in formulating the new Education Scheme, but he wished to say that considerable progress had already been made. While the present scheme was a good one, a still better scheme was in formation.

Mr. Donald Benson (President) proposed the toast of "The Chairman and members of the St. Helens Gas and Lighting Committee," coupling with it the names of Alderman W. Burrows, J.P., Chairman, and Mr. R. L. Greaves, the Engineer and Manager.

Responding to the toast, Alderman Burrows referred to the ability with which Mr. Greaves had served the Gas Committee.

Colonel Guy Pilkington supported the Chairman.

Mr. Greaves thanked the previous speakers for their personal references to himself, and also the Gas Committee for giving him every facility in arranging the visit.

Mr. F. Cartledge (Oldham) proposed the toast of the "United Glass Bottle Manufacturers, Ltd.," saying that everyone had been thoroughly impressed with the visit to the glassworks and the courtesy that had been extended to them.

In reply, Mr. S. Morris (Chief Engineer) referred to the great help they had received from Mr. Greaves in the solution of such problems as the reduction of the sulphur content of the gas to half a grain per 100 cu.ft.

The members were then conveyed to the Gas-Works, and showed considerable interest in the new design of top ironwork of the Glover-West vertical retort installation.

1944 "Journal" Directory

Page 16. CHESTER. T. L. Jones, *S.*, *vice* H. Hopkinson.
,, 26. EXETER. S. G. Ash, *S.*, *vice* E. H. Dart, deceased.
,, 38. KETTERING. J. F. Ford, *M. & S.*, *vice* T. E. Maddocks.

Diary

Dec. 13.—Southern Association of Gas Engineers and Managers (Eastern District): Gas Industry House, 2.30 p.m. Paper by C. A. Deas, "Horizontal Retort House Operation and Works Power Supply."

Dec. 14.—Midland Junior Gas Association: Chamber of Commerce Buildings, Birmingham, 4.15 p.m.

Institute of Fuel

The following meetings of the Institute have been arranged:

Wednesday, Dec. 13, at 2.30 p.m., at the Institution of Mechanical Engineers, the fourth Paper in the series on thermal insulation on "The Insulation of Buildings—Domestic and Industrial," by N. S. Billington.

Wednesday, Jan. 10, 1945, at 2.30 p.m. at The Institution of Electrical Engineers, Savoy Place, Victoria Embankment, a Paper on "Methane," by Sir Alfred Egerton, F.R.S., and Malcolm Pearce, B.Sc.(Eng.).

Thursday, Feb. 1, 1945, a Paper on "The Heating and Ventilation of Large Buildings," by Dr. Oscar Faber, O.B.E., M.Inst.C.E.

Thursday, Feb. 22, 1945. A Joint Conference on Atmospheric Pollution with the National Smoke Abatement Society:

MORNING SESSION.

Paper 1. "A Statement of the Problem," by Dr. Dobson, F.R.S., Chairman of the Atmospheric Pollution Committee.
,, 2. "The Effects on Civilization of Atmospheric Pollution," by Major S. F. Markham, M.P., M.A., B.Litt.

AFTERNOON SESSION: SMOKE PREVENTION.

,, 3. "Small Scale Steam Raising Plant," by S. N. Duguid.
,, 4. "Grit and Smoke from Power Stations," by John Bruce.
,, 5. "Industrial Furnaces," by Dr. R. J. Sarjant.
,, 6. "Kilns and Pottery Furnaces," by A. T. Green.
,, 7. "Domestic Smoke," by A. Blackie.
,, 8. "Railway Smoke," by M. G. Bennett.

A full discussion will follow the presentation of short summaries of the papers, after which the President will summarize "What can be done."

Fuel Economy Review for 1944*

How industrial plant can be adapted to burn substituted fuels (such as surface-mined coals, coke and coke breeze, and slurry) to meet difficulties caused by the falling off in coal production is one of the urgent topical problems expertly dealt with by contributors to the 1944 *Fuel Economy Review*.

Another article of special interest in this, the 23rd volume to be published by the F.B.I., discusses the underground gasification of coal, and describes experiments carried out in Russia, where it has been proposed that underground gasification stations should provide gas for town's supply, for electricity generation, and for chemical and other industries.

Among other subjects contributed by specialists with first-hand experience in fuel economy are the following: A recently modernized industrial steam-raising plant; the utilization of exhaust steam; heat transmission in Lancashire boilers; the industrial use of superheated steam; the need for close co-operation between management, technical staff, and production superintendents.

The *Review* includes the customary annual survey of technical developments in the gas and allied industries, and also carries useful notes, contributed by the F.B.I. Taxation Department, on the taxation and rating position as it affects expenditure on plant installed to save fuel. A diagram which gives at a glance the chief sources of loss of heat in economizers will be widely welcomed.

* Published by the Federation of British Industries, 21, Tothill Street, London, S.W.1. (Price 2s. 6d.)

In the Past Five Years employees of the Birmingham Gas Department have subscribed over £200,000 to National Savings, which is equivalent to 4s. per week per employee throughout the period.

The Next Meeting of the Midland Junior Gas Association will be held at the Chamber of Commerce Building, New Street, Birmingham, on Dec. 14, at 4.15 p.m. when two short Papers will be given as follows: (1) "Some Notes on Repairing Refractories in Vertical Retorts," by Mr. J. N. Shorrock, M.Sc. (Birmingham Gas Department). (2) "Some Notes on Retort House Chemical Control," by Mr. P. S. Gallaher, A.I.C. (Birmingham Gas Department).

An Interim Dividend of 7½% paid in August was confirmed as the final dividend for the year ended March 31 at the annual meeting of Falk, Stadelmann & Co., Ltd., in London on Nov. 29. The net profit for the year, after deducting staff pension contributions, N.D.C., and income tax, was £76,949, against £80,703 for the previous year, and the balance carried forward was £50,593, against £52,878 brought in. In his statement issued to the shareholders, Mr. Gustav Falk, who has succeeded Mr. Max Falk as Chairman, reported that while the works continued in the main to be employed on essential war requirements, they were also engaged on the production of some of their specialities required for Government sponsored schemes. A slight diminution in trading profit was mainly accounted for by restrictions arising out of the control of essential materials, quotas, &c., but in the current year business generally was being maintained. Quite recently the Company had acquired the goodwill, trade marks, and patents of a manufacturing company engaged in the lighting industry, and a subsidiary company had been formed to preserve the continuity of that business.

GAS PRODUCTS PRICES

The London Market Dec. 4.

There are no changes to report in the prices of Coal Tar Products.

A Government Order came into effect on March 1 controlling the price of Benzole and Coal Spirit and replacing the Control of Coal Tar Naphtha and Xylole Order, 1943.

The Order is known as the Control of Benzole and Coal Spirit Order, 1944 (S.R. & O. 1944, No. 172).*

By this Order the price of Motor Benzole is fixed at 2s. per gallon. The Order also lays down the method of evaluating Crude Benzole.

The Order also calls for periodical returns to the Ministry of Fuel and Power from all producers of Crude and Refined Benzole.

In connexion with the Coal Tar products market, the Government Order designated the Contol of Toluene (No. 4) Order, 1944 (S. R. & O. 1944, No. 170), contains an amendment of the Control of Toluene (No. 3) Order, 1943.

Attention is called to a new Government Order, which amends the price of Toluene as from Sept. 1, 1944. The Order is entitled, The Control of Benzole and Coal Spirit (No. 2) Order, 1944 (S. R. & O., No. 988).

The only change in connexion with the prices of Coal Tar Products refers to Naphthalene. A new Government Order, entitled the Coal Tar Products Prices (No. 2) Order, 1944 (S. R. & O. 1944, No. 1051), allows increases in the maximum prices for all forms of Naphthalene. The new Order came into force on Sept. 22, 1944.

* Slightly amended by Control of Benzole and Coal Spirit (No. 2) Order, 1944, which amendments came into force on Oct. 1.

The Provinces Dec. 4.

The average prices of gas-works products during the week were: Pitch and Crude Tar.* Toluole, naked, North, 90's, 2s. to 2s. 2½d., pure, 2s. 9d. (now controlled by S. R. & O. 1944, No. 988, operative from Sept. 1, 1944. Benzole and Coal Spirit, also Coal Tar Naphtha and Xylole, are now controlled by the Control of Benzole and Coal Spirit Order, 1944, dated Feb. 18, 1944, S. R. & O. 1944, No. 172, operative from March 1, and S. R. & O. 1944, No. 988, part 1, operative from Oct. 1, 1944. Carbolic acid, 60's, anthracene, creosote oil (hydrogenation), coal tar oils (timber preservation, &c.), and strained anthracene oil controlled by the Coal Tar Products Prices Order, 1943, dated Oct. 20, 1943 (S. R. & O. 1943, No. 1528), operative from Nov. 15, 1943. Naphthalene now controlled under S. R. & O. 1944, No. 1051, operative from Sept. 22, 1944.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Scotland Dec. 2.

Supply and demand are well balanced. Refined tar*: Yield to distillers is 4½d. per gallon *ex* Works, naked. Creosote oil: Timber preserving quality,* 5½d. to 6½d.; hydrogenation oil,* 5⅞d.; low gravity or virgin oil,† 7½d. to 7¾d.; benzole absorbing oil,* 6½d. to 8d. per gallon. Refined cresylic acid* is 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha†: 6½d. to 7d. per gallon. Solvent naphtha*: Basic prices delivered in bulk, 90/160 grade, 2s. 8d., and 90/190 Heavy naphtha, Unrectified, 1s. 10½d.; Rectified, 2s. 2d. per gallon. Pyridine†: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

* Price controlled. † Uncontrolled.

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